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The distributional effects of lotteries and auctions—License plate regulations in Guangzhou

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ABSTRACT

Lotteries and auctions are common ways of allocating public resources, but they have rarely been used simultaneously in urban transportation policies. This paper presents a unique policy experiment in Guangzhou, China, where lotteries and auctions are used in conjunction to allocate vehicle licenses. Guangzhou introduced vehicle license regulations to control the monthly quota of local automobile growth in 2012. To obtain a license, residents are required to choose between the lottery and auction method. Since the introduction of the regulations, there has been heated debates on the distributional effects of lotteries and auctions; however, the debates have not been grounded in empirical studies. We analyze the distributional effects of such mixed mode of resource allocation in a positive manner based on individual behavioral choices. We conducted a survey in January 2016 (n = 1000 people * 12 months), and used mixed logit models to analyze how socio-economic status, including income and household automobile ownership, determined people's choices among lottery, auction, and non-participation alternatives. We find that income increased participation, but did not influence non-car owners' choices between lotteries and auctions, which contrasts with the common notion that lotteries benefit the poor. Additionally, the positive impact of car ownership on participation indicates a car-dependent trajectory for automobile growth. The significant socio-economic differentiators between lotteries and auctions were age, gender, and education. Proxies of mobility needs were insignificant overall. The program attributes had a much larger impact than all other variables—people were more likely to choose lotteries with higher winning rates and more participants and more likely to choose auctions with higher prices and more participants. We concluded that for those who participated, the choice between lotteries and auctions did not depend on their income or mobility needs but, rather, the probability of winning plates and the opportunity for speculation.

1. Introduction

The transitional economy in China has significantly increased the number of individuals purchasing personal automobiles. Between 2000 and 2014, the total number of passenger car owners in China grew from 16.1 to 146 million (National Bureau of Statistics of China, 2015). This rapid growth has led to severe problems including air pollution, congestion, and energy consumption. Motor vehicles consume approximately 50% of the total oil consumed annually in China (Davis et al., 2008; Ma et al., 2012). To mitigate this unprecedented growth, Chinese local governments, including those of Beijing, Shanghai, Guangzhou, and four other major cities have implemented a series of license plate regulations. Beijing and Shanghai allocate car license plates by lottery and auction, respectively. In 2012, the Guangzhou government implemented license plate regulation characterized by its mixed allocation

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mode. Of the total license plates allocated, 50% were through lotteries, 40% through auctions, and 10% were assigned to new-energy vehicles. This study is fueled by the discussions on the distributional effects of lotteries and auctions, which have been heatedly debated by scholars and the public since the regulations were introduced. For example, although, theoretically, auctions are the most efficient way to allocate public resources, their use has been opposed by many who contend that auctions can harm the poor because the poor do not have the economic power to win license plates in such stiff competition (Xue, 2004; Ye, 2007). In contrast, others argue that auctions respect different levels of mobility needs and can yield revenues that are, in turn, invested in public transit to subsidize the poor (Fan, 2013; Nie, 2013).

This study analyzes the distributional effects by surveying how people behave under the mixed allocation rule in Guangzhou. In particular, we are interested in how socio-demographic variables, such as income and household automobile ownership[1], determine the choices among lottery, auction, and non-participation alternatives. Although the distributional effects of lotteries and auctions have been debated extensively in China, no past study has grounded its argument in solid empirical evidence. One critical reason is that there is no publicly available dataset that provides individual-level information. This study responds to this gap by drawing on results from a survey we conducted in January 2016, which captures the choice behaviors of 1000 Guangzhou residents in each of the months in 2015 during which they participated (up to 12 months). To elicit individual behaviors, we asked survey respondents to report their choices among lottery, auction, and non-participation alternatives in each month between January and December 2015. The survey included questions related to residents' income, socio-demographics, and travel information, which are the potential determinants of residents' choices. The dataset at the individual level allows us to analyze exactly how each resident behaved when faced with the choice between lottery, auction, and non-participation alternatives.

Beyond the application to license plate regulations, lotteries and auctions are generic ways to allocate limited public resources. Traditionally, scholars believe that lotteries benefit the poor while auctions benefit the rich (Sandel, 2010). However, the empirical evidence is rare for situations where lotteries and auctions are simultaneously employed. None of the cases have produced individual-level behavioral data. Therefore, the Guangzhou policy provides a rare opportunity to illustrate the tradeoff between lotteries and auctions in one single policy.

We choose Guangzhou as an exemplary case illustrating the license plate regulations in China. Fig. 1 shows that Shanghai was the first to limit license plate registration in 1994. After 16 years, Beijing implemented its own license plate regulation. The two policies are similar as both restrict automobile ownership growth; however, they differ in that Shanghai holds auctions to allocate license plates while Beijing conducts lotteries. In 2012, Guangzhou introduced its policy characterized by its mixed allocation rule. The evolution of the series of license plate regulations has shown that the mixed mode is becoming increasingly influential because several cities have adopted this mode emulating Guangzhou. As the first city to use the mixed mode, Guangzhou deserves close examination. In Guangzhou, each month, residents can obtain a license plate by choosing between a lottery and an auction, but they cannot choose both. Individuals can re-enter the process every month or choose to drop out. Once a person wins a license plate, they must register an automobile with the license plate within six months. The winner is not allowed to trade the license plate. The public dataset published by the Guangzhou government provides the total number of entrants in lotteries and auctions but not individual-level data. The published dataset shows that overall, people preferred lotteries to auctions. For example, in December 2015, the quota of the plates auctioned was 3550, and the quota allocated by lottery was 4840. However, in the same month, there were 12,804 auction participants and 415,644 lottery participants. Given the low winning rates of lotteries, auctions are a quick means of obtaining a license plate. In fact, this pattern of high winning rates of auctions and low winning rates of lotteries has been quite consistent since the beginning of this policy, as shown in Fig. 2(d). Fig. 2 shows how the numbers of entrants, quota, winning rates, and prices evolved during the past 36 months from 2013 to 2015. Please see the Appendix for the detailed mechanisms of this Guangzhou license policy.

The following section reviews the literature on lotteries and auctions and the Guangzhou case. The data collection and analytic method section introduces the survey, the key statistics and the specification of the models. Subsequently, we estimate and compare a multinomial logit model and a mixed logit model and discuss their limitations. The final section summarizes our findings and concludes.

2. Literature review

Lotteries and auctions are two common ways to allocate public resources such as health care, public housing, and recreational opportunities. Lotteries are often considered fair while auctions are perceived as efficient but unfair (Evans et al., 2009; Goodwin, 2013; Hofstee, 1990). Taylor et al. (2003) argue that a lottery is "usually employed to resolve allocation problems to reflect a spirit of fairness and equality, since everyone has an equal chance to win, regardless of whatever characteristics or qualities one may possess." Sandel (2010) argues that it is fair, particularly between the rich and the poor, to conscript people into the army through lotteries; however, the option of buying out after the lottery renders the process unfair because the poor are destined to be conscripted into the army.

Proponents of auctions often ground their argument in social welfare or efficiency (Cheung, 1974; Evans et al., 2009). Competition does not disappear after any price or quantity control but only takes different forms, such as waiting in queues, competing

[1] Automobile ownership in this study refers to household auto ownership, rather than individual auto ownership. Car owners refer to the individuals who are living in a household that has already owned cars, although they as individuals do not have a car registered under their names. This distinction is important because the policy does not allow individuals who have owned cars to participate in the policy. Hence only household automobile ownership is relevant.